SPECIFICATION

A BUSH MOUNTING MEMBER

FIELD OF THE INVENTION

This invention relates to a bush mounting member used for an automobile suspension arm, an engine mount, a ring, or the like.

TECHNICAL BACKGROUND

One example of this kind of bush mounting member used for an automobile is a suspension arm member such as an upper arm, a lower arm, a trailing arm and a torsion bar.

The suspension arm member of this kind is formed to have a shape corresponding to its installation space. One example thereof is shown in Figs. 34 and 35. The arm member (51) shown in Fig. 34 includes a main body (53) manufactured by punching a metallic plate in a generally V-shape and a pair of metal extruded bush mounting portions (54), (54) welded to both opposite ends of the main body (53). In Figs. 34 and 35, the reference numeral (53a) denotes a bent portion of the main body (53). The bush mounting portion (54) is provided with a circular bush mounting bore (55) in which a cylindrical vibro-isolating bush (52) with a rubber elastic portion is forcibly fitted.

However, since the aforementioned conventional arm member

(51) is formed by welding the bush mounting portion (54) to the main body (53), it was troublesome to manufacture the arm member (51). Also, since there may exist welding defects caused by, e.g., cracks in the welded portion (56), the arm member lacks in strength reliability. On the other hand, as shown in Figs. 36 and 37, an arm member (61) in which bush mounting bores (64)(64) are formed by boring the main body (63) has been proposed. However, in the arm member (61), since the main body (63) is manufactured by punching a metallic plate, the metallic plate has to be thin enough for punching it. Therefore, in a state that a bush (62) is mounted in the bush mounting bore (64), the contact area between the bush (62) and the inner surface of the bush mounting bore (64) is small. As a result, the bush (62) mounted in the bush mounting bore (64) lacks in stability, and easily slips out of the bush mounting bore (64).

In particularly, since the arm member (61) has a bent main body (63), in a case where the bush (66) is loaded in the direction of changing the radius of curvature of the bent portion (63a), e.g., in the direction of the arrow C or D shown in Fig. 36 to cause a bending moment on the bent portion (63a) of the main body (63), the bush (62) easily slips out of the bush mounting bore (64) in the bending direction of the main body (63) or in the direction opposite to the bending direction. In other words, the bush (62) is loaded by the component C1 of the load C in the bending direction, or by the component D1 of the load D in the direction opposite to the bending direction. Thus, the bush (62) is moved in the bending direction or in the direction

opposite to the bending direction. In Fig. 36, the point P denotes the center of curvature of the bent portion (63a) of the main body (63).

Furthermore, the main body (63) may easily be broken at the bending side peripheral portion (65) of the bush mounting bore (64) or its opposite peripheral portion (66) of the bush mounting bore (64) when the component C1 of the load C in the bending direction or the component D1 of the load D in the direction opposite to the bending direction is imposed to the main body (63).

The present invention is made in view of the aforementioned technical background. One of the objects of the present invention is to provide a bush mounting member including a bar-shaped main body having a bent portion, wherein the bush mounting member has high strength reliability and is low in manufacturing cost, and the bush mounting member has a bush tightly mounted thereto.

The other objects of the present invention will be apparent from the following preferred embodiments of the present invention.

SUMMARY OF THE INVENTION

According to the first aspect of the present (hereinafter referred to as a "first invention" in this chapter), a bush mounting member includes:

a main body made of a bar-shaped metal extruded pipe and has a bent portion; and

a bush mounted in a bush mounting bore, the bush mounting bore being formed at a part of the main body so as to penetrate opposite peripheral walls constituting the part and opposing in a direction perpendicular to both of an axial direction of the main body and a bending direction of the main body,

wherein the bush is mounted in the bush mounting bore such that at least opposite sides of the bush opposing in the bending direction are supported by and between opposite peripheral walls constituting the part and opposing in the bending direction, and supported along a thickness direction of the bush.

According to the first invention, since the main body is made of a bar-shaped metal extruded pipe, the main body can be manufactured effectively and can decrease the manufacturing cost. Furthermore, a lightweight bush mounting member can be provided.

Also, since the bush is mounted in the bush mounting bore formed in the main body, troublesome processes such that a bush mounting frame is welded to a main body as shown in the prior art can be omitted, resulting in enhanced manufacturing efficiency. In addition, since there is no welding portion, the strength reliability of the bush mounting member can be improved.

Since opposite sides of the bush opposing in the bending direction are supported by and between opposite peripheral walls constituting the part and opposing in the bending direction, and supported along a thickness direction of the bush, opposite portions of the peripheral wall opposing in the bending direction exist at the opposite peripheral portions of the bush mounting bore opposing in the bending direction of the main body.

Accordingly, even in a case where the bush is loaded as illustrated in the explanation of the prior art, a breakage to the aforementioned opposite portions of the main body due to the component of the load in the bending direction or the component of the load in the direction opposite to the bending direction can be prevented by the opposite portions of the peripheral wall opposing in the bending direction. Furthermore, since the opposite sides of the bush opposing in the bending direction are supported along a thickness direction of the bush, the stability of the bush in the bush mounting bore is enhanced. Thus, the movement of the bush in the bending direction or in the direction opposite to the bending direction can be surely prevented.

In the first invention, it is preferable that the opposite sides of the bush opposing in the bending direction are fitted to opposing surfaces of the opposite peripheral walls along the direction perpendicular to both of the axial direction and the bending direction of the main body, whereby the opposite sides of the bush are supported by and between the opposite peripheral walls opposing in the bending direction, and supported along the thickness direction of the bush.

In the first invention, it is preferable that a pair of opposing inner walls extending in the axial direction are provided between the peripheral walls opposing in the bending direction, the inner walls connecting the peripheral walls opposing in the direction perpendicular to both of the axial direction and the bending direction of the main body, wherein the opposite sides of the bush opposing in the bending direction are

fitted to the opposing surfaces of the inner walls along the direction perpendicular to both of the axial direction and the bending direction of the main body, and whereby the opposite sides of the bush opposing in the bending direction are supported by the opposing surfaces of the inner walls along the thickness direction of the bush.

With this structure, at the opposite sides of the bush mounting bore opposing in the bending direction of the main body, opposite portions of the peripheral wall opposing in the bending direction and the inner walls exist. Therefore, the aforementioned opposite sides is extremely strong. As a result, even in a case where the bush is loaded as illustrated in the explanation of the prior art, a breakage to the aforementioned opposite sides of the main body due to the component of the load in the bending direction or the component of the load in the direction opposite to the bending direction can be surely prevented.

In the first invention, it is preferable that at least one of the peripheral walls opposing in the direction perpendicular to both of the axial direction and the bending direction of the main body is provided with a pair of ridges on an outer surface thereof, the ridges being spaced apart from each other and each extending along the axial direction, and wherein the opposite sides of the bush opposing in the bending direction are sandwiched between opposing surfaces of the ridges plastically deformed.

With this structure, since the opposite sides of the bush

opposing in the bending direction are sandwiched between opposing surfaces of the ridges plastically deformed, the stability of the bush in the bush mounting bore can further be enhanced.

In the first invention, it is preferable that a core is fitted in between the peripheral walls opposing in the bending direction, and wherein the opposite sides of the bush opposing in the bending direction are fitted to an inner surface of a bush mounting bore formed in the core along the direction perpendicular to both of the axial direction and the bending direction of the main body, whereby the opposite sides of the bush are supported by the core along the thickness direction of the bush.

With this structure, the opposite walls of the peripheral wall of the main body opposing in the bending direction and portions of the core opposing in the bending direction exist at the opposite portions of the peripheral portion of the bush mounting bore. Therefore, the opposite portions of the peripheral portion of the bush mounting bore has enhanced strength. Accordingly, even in a case where the bush is loaded as illustrated in the explanation of the prior art, a breakage to the aforementioned opposite sides of the main body due to the component of the load in the bending direction or the component of the load in the direction opposite to the bending direction can be surely prevented.

In the first invention, it is preferable that a peripheral wall of the bent portion of the main body is plastically deformed in a flat shape.

With this structure, the bending stiffness of the bent portion can be enhanced.

In the first invention, it is preferable that at least one of the opposite peripheral walls opposing the bending direction is provided with an outer wall or ridge on an outer surface thereof along the axial direction.

With this structure, a bending stiffness of the bent portion of the main body can be enhanced.

In the first invention, it is preferable that a cut-out portion for preventing an obstacle is formed on an outer surface of at least one of the peripheral walls opposing in the bending direction.

With this structure, the bush mounting member can be installed without being disturbed by an obstacle located near the installation place.

In the first invention, it is preferable that the bush is forcibly fitted in the bush mounting bore.

In the first invention, it is preferable that the pipe is made of an aluminum or its alloy. This enables to lighten the bush mounting member.

In the first invention, it is preferable that the bush has a rubber elastic portion.

According to the second aspect of the present invention (hereinafter referred to as a "second invention"), a bush mounting member includes a main body made of a metal extruded article having a pair of opposing side walls and a connecting wall connecting the side walls, the main body is bent to have a

bent portion with one of the side walls facing inside and the other thereof outside, and a bush mounted in a bush mounting bore penetrated in the connecting wall constituting a part of an axial direction of the main body. The bush is mounted in the bush mounting bore such that at least opposite sides of the bush opposing in the bending direction are supported along a thickness direction of the bush between the side walls of the main body.

According to the second invention, with the same reason as in the first invention, the main body can be manufactured effectively and can decrease the manufacturing cost. Furthermore, a lightweight bush mounting member can be provided.

Also, since the bush is mounted in the bush mounting bore formed in the main body, the manufacturing effectiveness can be further enhanced, and the strength reliability of the bush mounting member can be improved.

Since the opposite sides of the bush opposing in the bending direction are supported by and between the opposite side walls and along a thickness direction of the bush, the opposing portions of the peripheral portion of the bush mounting bore opposing in the bending direction have opposing side walls of the main body. Accordingly, even in a case where the bush is loaded as illustrated in the explanation of the prior art, a breakage to the aforementioned opposing portions of the main body due to the component of the load in the bending direction or the component of the load in the direction opposite to the bending direction can be surely prevented. Also, since the opposite

sides of the bush opposing in the bending direction are supported along a thickness direction of the bush, the stability of the bush in the bush mounting bore is enhanced. Thus, the movement of the bush in the bending direction or in the direction opposite to the bending direction can be surely prevented.

In the second invention, it is preferable that the opposite sides of the bush opposing in the bending direction are fitted to opposing surfaces of the side walls along the direction perpendicular to both of the axial direction and the bending direction of the main body between the side walls, whereby the opposite sides of the bush are supported by the side walls along the thickness direction of the bush.

In the second invention, it is preferable that the bush is forcibly fitted in the bush mounting bore.

In the second invention, it is preferable that the extruded article is made of an aluminum or aluminum alloy. This enables to lighten the bush mounting member.

In the second invention, it is preferable that the bush has a rubber elastic portion.

BRIEF DESCRIPTION OF DRAWINGS

Fig. 1 is a plan view of the bush mounting member according to the first embodiment of the present invention.

Fig. 2 is a vertical cross-sectional view of the bush mounting member according to the first embodiment of the present invention.

Fig. 3 is a cross-sectional view taken along the lines 103-

103 in Fig. 1.

Fig. 4 is a cross-sectional view taken along the lines 104-104 in Fig. 1.

Fig. 5 is a cross-sectional view taken along the lines 105-105 in Fig. 1.

Fig. 6 is a perspective view of a part of a main body showing a manufacturing process of the bush mounting member according to the first embodiment of the present invention.

Fig. 7 is a perspective view of the bent main body showing the manufacturing process of the bush mounting member according to the first embodiment of the present invention.

Fig. 8 is a perspective view of the main body illustrating the manufacturing process of the bush mounting member according to the first embodiment of the present invention after forming a bush mounting bore and a cut-out portion for preventing an obstacle showing.

Fig. 9 is a perspective view of an end portion of the main body during mounting the bush into the bush mounting bore according to the first embodiment of the present invention.

Fig. 10 is a perspective view of the end portion of the main body after the bush is mounted in the bush mounting bore according to the first embodiment of the present invention.

Fig. 11 is a cross-sectional view taken the lines 111-111 in Fig. 9.

Fig. 12 is a perspective view of an end portion of a main body during mounting a bush into a bush mounting bore according to the second embodiment of the present invention.

Fig. 13 is an end view of the end portion of the main body after mounting the bush into the bush mounting bore according to the second embodiment of the present invention.

Fig. 14 is a cross-sectional view taken the lines 114-114 in Fig. 13.

Fig. 15 is an end view of an end portion of a main body during mounting a bush into a bush mounting bore according to the third embodiment of the present invention.

Fig. 16 is a perspective view of the end portion of the main body after the bush is mounted in the bush mounting bore according to the third embodiment of the present invention.

Fig. 17 is a cross-sectional view taken along the lines 117-117 in Fig. 16.

Fig. 18 is a plan view of an end portion of a main body before deforming the ridges according to the fourth embodiment of the present invention.

Fig. 19 is a plan view of the end portion of the main body after deforming the ridges according to the fourth embodiment of the present invention.

Fig. 20 is a perspective view of an end portion of a main body during fitting a core according to the fifth embodiment of the present invention.

Fig. 21 is a perspective view of the end portion of the main body during mounting a bush into a bush mounting portion according to the fifth embodiment of the present invention.

Fig. 22 is a perspective view of an end portion of a main body before mounting a bush into a bush mounting portion

according to the sixth embodiment of the present invention.

Fig. 23 is a plan view of the end portion of the main body before mounting the bush into the bush mounting portion according to the sixth embodiment of the present invention.

Fig. 24 is a cross-sectional view taken along the lines 124-124 in Fig. 23.

Fig. 25 is a perspective view of a main body before mounting a bush into a bush mounting bore according to the seventh embodiment of the present invention.

Fig. 26 is a cross-sectional view taken along the lines 126-126 in Fig. 25.

Fig. 27 is a perspective view of a main body before mounting a bush into a bush mounting bore according to the eighth embodiment of the present invention.

Fig. 28 is a plan view of an end portion of the main body before mounting the bush into the bush mounting bore according to the eighth embodiment of the present invention.

Fig. 29 is a cross-sectional view taken along the lines 129-129 in Fig. 28.

Fig. 30 is a perspective view of an end portion of a main body before mounting a bush into a bush mounting bore according to the ninth embodiment of the present invention.

Fig. 31 is a plan view of the end portion of the main body before mounting the bush into the bush mounting bore according to the ninth embodiment of the present invention.

Fig. 32 is a perspective view of an end portion of a main body before mounting a bush into a bush mounting bore according

to the tenth embodiment of the present invention.

Fig. 33 is a plan view of the end portion of the main body before mounting the bush into the bush mounting bore according to the tenth embodiment of the present invention.

Fig. 34 is a plan view according to one example of a conventional bush mounting member.

Fig. 35 is a cross-sectional view taken along the lines 135-135 in Fig. 34.

Fig. 36 is a plan view according to another example of a conventional bush mounting member.

Fig. 37 is a cross-sectional view taken along the lines 137-137 in Fig. 36.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

A bush mounting member according to the embodiments of the present invention will be explained with reference to the attached drawings. The bush mounting members according to the following embodiments are used as an automobile suspension member. Therefore, the bush mounting member in each of the following embodiments is referred to as "an arm member."

Figs. 1 to 11 show the first embodiment of the present invention. In Fig. 1, the reference numeral (1) denotes an arm member of the first embodiment.

As shown in Fig. 1, the arm member (1) includes a main body (3) made of an aluminum (including its alloy; hereinafter referred to as "aluminum") extruded flat pipe with a predetermined length and having cylindrical vibro-isolating

bushes (2)(2) with a rubber elastic member. The bushes (2)(2) are forcibly fitted in circular bush mounting bores (9)(9) penetrated in both end portions of the main body (3) in the thickness direction.

As shown in Fig. 3, the thickness of the main body (3) is the same as that of the bush (2). The inner diameter of the bush mounting bore (9) is slightly smaller than the outer diameter of the bush (2) so that the bush (2) can be forcibly fitted in the bush mounting bore (9). As mentioned above, since the thickness of the main body (3) is the same as that of the bush (2), both the end portions of the bush (2) in the thickness direction do not protrude from the bush mounting bore (9) in a state that the bush (2) is mounted in the bush mounting bore (9). In the central portion of the bush (2), a supporting member (2a) penetrating in the thickness direction of the bush (2) is provided.

As shown in Fig. 6, the peripheral wall of the main body (3) is comprised of a pair of first and second flat walls (4)(5) facing each other in a tapered manner toward its width direction thereof and a pair of third and fourth walls (6)(7) each having a generally arc-shape and connecting the lateral end portions of the first and second walls (4)(5). The thickness of the third wall (6) is larger than that of the fourth wall (7). In Fig. 6, the reference numeral (8) denotes a hollow portion of the main body (3).

As shown in Fig. 7, the main body (3) is formed to have a generally V-shape by forcibly bending the pipe at the

longitudinal central portion by a known bending method with the third wall (6) facing inside and the fourth wall (7) outside.

Accordingly, in the main body (3) of the arm member (1), the third wall (6) constitutes the wall of the peripheral wall of the main body (3) located at the bending direction side and the fourth peripheral wall (7) constitutes the wall of the peripheral wall of the main body (3) located at the side opposite to the bending direction side. Also, the first and second peripheral walls (4)(5) constitute the opposite walls of the peripheral wall of the main body (3) opposing in the direction perpendicular to both of the axial direction and the bending direction. Thus, the thickness direction of the main body (3) coincides to the direction perpendicular to both the axial direction and the bending direction of the main body (3).

Next, as shown in Fig. 8, each end portion of the bent pipe is punched to have a circular bush mounting bore (9) penetrating the first and second peripheral walls (4)(5) in the thickness direction of the main body (3).

In bending the pipe, since the thickness of the third peripheral wall (6) is larger than that of the fourth peripheral wall (7) as mentioned above, the pipe can be bent easily.

A method for bending the pipe is not specifically limited. For example, a press bending method or a rotation bending method can be employed, and various bending machine such as a pipe bender, a stretch bender or FCBP can be used for bending the pipe.

The bush mounting bore (9) may be formed by, for example,

punching or machining the main body (3).

Furthermore, in forming the bore (6), arc-shaped cut-out portions (11)(11) for preventing an obstacle are formed by cutting out the outside portions of the third and fourth peripheral walls (6)(7) near the bush mounting bores (9)(9). The cut-out portions (11)(11) are formed so that the main body (3) can avoid an obstacle which may exist near the installation place.

As shown in Figs. 1 and 2, a small hole (12) is formed in the first and second peripheral walls (4)(5) so as to communicate the hollow portion (8) with an outside for releasing air, water, etc.

As shown in Figs. 9 to 11, the aforementioned bush mounting bores (9)(9) are formed through the first and second peripheral walls (4)(5) at both end portions of the main body (3). In the bush mounting bores (9)(9), concave portions (10)(10) are formed in the third and fourth peripheral walls (6)(7) so as to oppose in the width direction of the main body (3). The concave portions (10)(10) extend along the direction perpendicular to both the axial direction and the bending direction, namely, along the thickness direction of the main body (3). In the bush mounting bores (9)(9), the bush (2) is forcibly fitted.

In a state that the bush (2) is mounted in the bore (9), opposite sides of the bush (2) opposing in the bending direction of the main body (3), namely, opposite sides of the bush (2) in the width direction of the main body (3), are fitted to the inner

surfaces of the concave portions (10)(10) formed in the opposing surfaces of the third and fourth peripheral walls (6)(7) along the thickness direction. Thus, the opposite sides of the bush (2) are supported by the concave portion (10)(10) along the entire thickness direction of the bush (2). On the other hand, both sides of the bush (2) opposing in the axial direction of the main body (3) are fitted to the inner surfaces of the bush mounting bores (9)(9) formed in the first and second peripheral walls (4)(5), thereby partly supported.

Since the main body (3) manufactured as mentioned above is made of a pipe, the arm member (1) is light in weight. Furthermore, since the pipe is made of an aluminum, the arm member (1) is extremely light in weight. In addition, since the aluminum pipe is made of an extruded article, the pipe can be effectively manufactured at low cost. Also, since the bush (2) is mounted in the bush mounting bore (9) formed in main body (3), the arm member (1) has no welding portion, resulting in high strength reliability.

The arm member (1) is to be attached to an automobile body frame (not shown) via the bushes (2)(2) mounted in the bush mounting bores (9)(9). As shown in Fig. 1, a load A may be imposed to the bushes (2)(2) in a direction that the bushes (2)(2) approach, or a load B may be imposed to the bushes (2)(2) in a direction that the bushes (2)(2) move apart. In other words, the bushes (2)(2) may be loaded so as to be changed the radius of curvature of the bent portion (3a). Thus, a bending moment is imposed to the bent portion (3a) of the main body (3).

The load A or B imposed to the bushes (2)(2) is received elastically by the bent portion (3a) of the main body (3) to cause an elastic deformation of the bent portion (3a) by the load A or B. In Fig. 1, the point O denotes the center of curvature of the bent portion (3a). In Fig. 4, the axis y denotes a neutral axis in the cross-section of the bent portion (3a) with regard to the bending moment imposed thereto.

In the arm member (1), in a case where the load A is imposed to the bushes (2)(2), the bush (2) starts to move toward the third peripheral wall (6) of the main body (3) by the component A1 of the load A in the bending direction of the main body (3). However, as mentioned above, since the third peripheral wall side portion of the bush (2) is supported along the entire thickness direction thereof, the bush (2) is surely prevented from moving toward the third peripheral wall (6) side. With the same reason, in a case where the load B is imposed to the bushes (2)(2), since the fourth peripheral wall side portion of the bush (2) is supported along the entire thickness direction of the bush (2), the bush (2) is surely prevented from moving toward the fourth peripheral wall (7).

In the arm member (1), since the opposite peripheral portions of the bush mounting bore (9) opposing in the bending direction are fitted to the third and fourth peripheral walls (6)(7), these opposite portions are strong enough to endure loads. Accordingly, in a case where the load A or the load B is imposed to the bushes (2)(2), a breakage to the aforementioned opposite peripheral portions of the bush mounting bore (9), due

to the component A1 of the load A in the bending direction or the component B1 of the load B in the opposite bending direction, can be prevented by the third or fourth peripheral wall (6)(7).

The present invention is not limited to the aforementioned first embodiment. For example, the present invention can be embodied by the following second to eighth embodiments. The same reference numerals are allotted to the same or similar elements in the following embodiments as in the first embodiment.

Figs. 12 to 14 show the second embodiment of the present invention. In an arm member (1) of the second embodiment, the main body (3) is made of an aluminum extruded square pipe with a predetermined length. A peripheral wall of the main body (3) includes a pair of opposing flat first and second peripheral walls (4)(5) and a pair of opposing flat third and fourth peripheral walls (6)(7) connecting the lateral end portions of the first and second peripheral walls (4)(5). Furthermore, between the third and fourth peripheral walls (6)(7), a pair of reinforcing inner walls (13)(13) are integrally formed to the first and second peripheral walls (4)(5) so as to connect them along the axial direction of the main body (3).

Although it is not shown in the drawings, the main body (3) is formed to have a generally V-shape by bending the hollow square pipe at the longitudinal middle portion thereof with the third peripheral wall (6) facing inside and the fourth peripheral wall (7) outside.

The bush mounting bores (9)(9) are formed in the first and second peripheral walls (4)(5) of both end portions of the main

body (3). In the opposing surfaces of both the inner walls (13)(13), concave portions (10)(10), which constitutes the opposite portions of the bush mounting bores (9)(9) opposing in the width direction of the main body (3), are formed along the thickness direction of the main body (3). As shown in Figs. 12 to 14, the bush (2) is forcibly fitted into the bush mounting bore(9).

In a state that the bush (2) is mounted in the bore (9), between the third and fourth peripheral walls (6)(7), the opposite portions of the bush (2) opposing in the width direction of the main body (3) are fitted to the inner surfaces of the concave portions (10)(10) formed on the opposing surfaces of the inner walls (13)(13) along the thickness direction of the main body (3). Thus, the aforementioned opposite portions of the bush (2) are supported along the entire thickness thereof.

In the arm member (1), the opposite portions of the peripheral wall of the bush mounting bore (9) opposing in the bending direction of the main body (3) are provided with the third peripheral wall (6) and the one of the inner walls (13) as well as the fourth peripheral wall (7) and the other of the inner walls (13). Therefore, the aforementioned opposite portions are extremely strong. Accordingly, in a case when the aforementioned load A or load B is imposed to the bushes (2)(2), a breakage to the aforementioned opposite portions of the peripheral portion of the bush mounting bore (9), due to the component A1 of the load A in the bending direction or the component B1 of the load B in the opposite bending direction, can surely be prevented by

the third peripheral wall (6) and the inner wall (13), or the fourth peripheral wall (6) and the inner wall (13).

Figs. 15 to 17 show the third embodiment of the present invention. In the main body (3) of the arm member (1) of the third embodiment, two pairs of outer ridges (14)(14), (14)(14) spaced apart from each other are integrally formed on the outer surfaces of first and second peripheral walls (4)(5) so as to correspond to the inner walls (13)(13) along the axial direction of the main body (3).

At both end portions of the main body (3), bush mounting bores (9)(9) are formed through the first and second peripheral walls (4)(5). The opposite portions of the bush (2) opposing in the width direction of the main body (3) are fitted to the opposing surfaces of the inner and outer walls (13)(13)(14)(14) in a line-to-line contact manner along the axial direction of the bush (2). As shown in Figs. 15 to 17, the bush (2) is forcibly fitted in the bush mounting bores (9)(9).

In a state that the bush (2) is mounted, the opposite portions of the bush (2) opposing in the width direction of the main body (3) are fitted to the opposing surfaces of the inner and outer walls (ridges) (13)(13)(14)(14) along the thickness direction of the main body (3), whereby the aforementioned portions are supported in a line-to-line contact manner along the entire thickness length.

Figs. 18 and 19 show the fourth embodiment of the present invention. The main body (3) of the arm member (1) according to the fourth embodiment has the same structure as that of the third

embodiment. The bush (2) is forcibly fitted in a bush mounting bore (9).

As shown in Fig. 19, in the arm member (1), a pair of outer ridges (14)(14) are plastically deformed along the outer surface of the bush (2) so that the bush (2) is clumped by the opposing surfaces of the outer ridges (14)(14). Thus, the bush (2) can be firmly supported, and the stability of the bush (2) in the bush mounting bore (9) can be further improved.

Figs. 20 and 21 show the fifth embodiment of the present invention. The main body (3) of the arm member (1) according to the fifth embodiment is made of an aluminum extruded square pipe with a predetermined length. The peripheral wall of the main body (3) includes a pair of opposing first and second peripheral walls (4)(5) of a flat-plate shape and a pair of opposing third and fourth peripheral walls (6)(7) of a flat-plate shape connecting both end portions of the first and second peripheral walls (4)(5). The main body (3) is formed to have a generally V-shape by bending the square pipe at the longitudinal central portion with the third peripheral wall (6) facing inside and the fourth peripheral wall (7) outside.

As shown in Fig. 20, a reinforcing plate-shaped core (15) made of an aluminum is forcibly fitted between the third and fourth peripheral walls (6)(7). Bush mounting bores (9)(9)(16) are formed at the opposite end portions of the main body (3) along the thickness direction of the main body (3).

As shown in Fig. 21, the bush(2) is forcibly fitted in the bush mounting bores (9)(9)(16).

In a state that the bush (2) is mounted, the opposite sides of the bush (2) opposing in the width direction of the main body (3) and the opposite sides of the bush (2) opposing in the axial direction of the main body (3) are fitted to the inner surfaces of the bush mounting bore (16) formed in the core (15) and the first and second walls (4)(5) along the thickness direction of the main body (3) in a surface-to-surface contact state. Thus, the bush (2) are supported by the aforementioned inner surfaces along the entire thickness direction of the main body (3).

In the arm member (1), the opposite portions of the bush mounting bore (9) opposing in the bending direction are extremely strong because the third peripheral wall (6) and a part of the core (15) as well as the fourth peripheral wall (7) and a part of the core (15) exist. Thus, in a case where the load A or the load B is imposed to the bush (2), a breakage to the aforementioned portions caused by the component A1 of the load A in the bending direction of the main body (3) or the component B1 of the load B in the opposite bent portion of the main body (3) is surly prevented by the third peripheral wall (6) and a part of core (15) as well as the fourth peripheral wall (7) and a part of the core (15).

Figs. 22 to 24 show the sixth embodiment of the present invention.

The main body (3) of the arm member (1) according to the sixth embodiment is made of an aluminum extruded round pipe with a predetermined length. As shown in Fig. 22, the main body (3) is formed to have a generally V-shape by bending the round pipe

at the longitudinal central portion.

In peripheral walls (4')(5') at the end portions of the main body (3) opposing in the direction perpendicular to both the axial direction and the bending direction, bush mounting bores (9)(9) are formed. At the opposing inner surfaces of the peripheral walls (6')(7') opposing in the bending direction, concave portions (10) (10), which constitutes the portions opposing in the bending direction of the main body (3) in the bush mounting bores (9)(9), are formed in the direction perpendicular to both the axial direction and the bending direction of the main body (3).

A bush (not shown) is forcibly fitted in the bush mounting bores (9)(9).

In a state that the bush is mounted, the opposite portions of the bush opposing in the bending direction of the main body (3) are fitted to the inner surfaces of the concave portions (10)(10) in a surface-to-surface contact state along the direction perpendicular to both of the axial direction and the bending direction. Thus, the aforementioned portions of the bush are supported along the entire thickness length.

Figs. 25 and 26 show the seventh embodiment of the present invention. In a main body (3) of an arm member (1) of the seventh embodiment, the following plastic working is applied to the bent portion (3a) of the main body (3) of the arm member (1) according to the sixth embodiment.

In the arm member (1), the peripheral wall of the bent portion (3a) of the main body (3) is plastically deformed by a

press or the like in the direction perpendicular to both the axial direction and the bending direction of the main body (3) to have a generally oval shape in cross-section.

In the arm member (1), since the bent portion (3a) of the main body (3) is plastically deformed to have a generally flat shape in a plane including both the axial direction and the bending direction of the main body (3), a bending stiffness (flexural rigidity) is enhanced at the bent portion (3a). Thus, in a case where aluminum material having Young's modulus of about one third of that of iron material is used for the main body (3), a strength required as an arm member can be surely obtained.

Figs. 27 to 29 show the eighth embodiment of the present invention. The main body (3) of the an arm member (1) according to the eighth embodiment is made of an aluminum extruded hollow square pipe with a predetermined length. A peripheral wall of the main body (3) includes a pair of first and second flat peripheral walls (4)(5) opposing each other and a pair of flat third and fourth flat peripheral walls (6)(7) opposing each other and connecting both end portions of the first and second peripheral walls (4)(5) in the width direction. Furthermore, reinforcing ridges (17)(17) are integrally formed along the axial direction on an outer surfaces of the third and fourth peripheral walls (6)(7).

The main body (3) is formed to have a generally V-shape by bending the hollow square pipe at the longitudinal central portion with the third peripheral wall (6) facing inside and the fourth peripheral wall (7) outside.

In the first and second peripheral walls (4)(5) at both end portions of the main body (3), bush mounting bores (9)(9) are formed. An opposite surfaces of the third and fourth peripheral walls (6)(7) are fitted to the opposite sides of the bush along the thickness direction of the bush in a line-to-line contact state. The bush is forcibly fitted in the bush mounting bores (9)(9).

In a state that the bush is mounted, the opposite sides of the bush opposing in the width direction of the main body (3) are fitted to the opposing surfaces of the walls (6)(7) along the thickness direction of the main body (3) in a line-to-line contact state between the third and fourth walls (6)(7). Thus, the aforementioned opposite sides of the bush are supported in the entire thickness length thereof.

In the arm member (1), since the outer ridged (17)(17) are provided on the outer surfaces of the third and fourth walls (6)(7) of the peripheral wall of the main body (3), the bending stiffness at the bent portion (3a) is enhanced. Therefore, the strength required as an arm member can be obtained.

Furthermore, as shown in Fig. 27, a cut-out portion (11) for preventing an obstacle can be formed in the outer ridges (17)(17). Thus, there is an advantage that such a cut-out portion (11) can be formed easily.

This invention is not limited to the aforementioned first to eighth embodiments. For example, the present invention can be embodied by the following ninth and tenth embodiments.

Figs. 30 and 31 show the ninth embodiment of the present

invention. The main body (23) of the arm member (21) according to the tenth embodiment is made of an aluminum extruded article of a channel shape with a predetermined length. This extruded article includes a pair of opposing side walls (24)(25) and a connecting wall (26) which connects the ends of the side walls (24)(25). The main body (23) is bent to have a generally V-shape at the longitudinal central portion with the one the side walls (24) facing inside and the other of the side walls (25) outside.

In the connecting wall (26) at the both end portions of the main body (23), a bush mounting bore (27) is penetrated in the thickness direction. On the opposing surfaces of the side walls (24)(25), concave portions (28)(28), which constitute opposite sides of the bush mounting bore (27) opposing in the width direction of the main body (23), are formed in the thickness direction of the main body (23). The bush is forcibly fitted in the bush mounting bore (27).

In a state that the bush is mounted, the opposite sides of the bush opposing in the width direction of the main body (23) are fitted to the inner surfaces of the concave portions (28)(28) formed on the opposing surfaces of the side walls (24)(25) in a surface contact state along the thickness direction of the main body (23). Therefore, the aforementioned sides of the bush are supported along the entire thickness length.

Figs. 32 and 33 show the tenth embodiment of the present invention. The main body (23) of the arm member (21) according to the tenth embodiment is made of an aluminum extruded article of a H-shape with a predetermined length. This extruded article

includes a pair of opposing side walls (24)(25) and a connecting wall (26) which connects the widthwise central portion of the side walls (24)(25). The main body (23) is bent to have a generally V-shape at the longitudinal central portion with one of the side walls (24) facing inside and the other of the side walls (25) outside.

At the connecting wall (26) at both end portions of the main body (23), a bush mounting bore (27) is penetrated in the thickness direction. In the opposing inner surfaces of the side walls (24)(25), concave portions (28)(28), which constitute opposite sides of the bush mounting bore (27) opposing in the width direction of the main body (23), are formed in the thickness direction of the main body (23). The bush is forcibly fitted in the bush mounting bore (27).

In a state that the bush is mounted, the opposite sides of the bush opposing in the width direction of the main body (23) are fitted to the inner surfaces of the concave portions (28)(28) in a surface-to-surface contact state along the thickness direction of the main body (23). Therefore, the aforementioned opposite sides of the bush are supported along the entire thickness length.

The present invention is not limited to the aforementioned embodiments. For example, a bush mounting member according to the present invention is not limited to the suspension arm member (1) or (21). It may be an engine mounting member.

The present invention claims a priority based on Japanese Patent Application No. H10-202061 filed on July 16, 1998, the

content of which is incorporated hereinto by reference in its entirety.

The terms and descriptions in this specification are used only for explanatory purposes and the present invention is not limited to these, but many modifications and substitutions may be made without departing from the spirit of the scope of the present invention which is defined by the appended claims.

POSSIBILITY OF INDUSTRIAL USAGE

The bush mounting member according to the present invention can be manufactured effectively at low cost. And it is light in weight and has high strength reliability. Furthermore, a bush is firmly fitted in a bush mounting bore, the stability of the bush in the bush mounting bore is high. Therefore, the bush mounting member of the present invention can be appropriately used for an automobile suspension arm, an engine mount, a ring, or the like.